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PTO/SB/05 (12/97)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney docket No. 00-1010	Total Pages 22
First Named Inventor or Application Identifier	
Richard A. Bramley, Jr.	
Express Mail Label No.	EF336478970US

09/687007 U.S. PTO
10/13/00

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: **Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231**

1. [x] Fee Transmittal Form *(Submit an original, and a duplicate for fee processing)*
2. [x] Specification [*Total Pages* 11] *(preferred arrangement set forth below)*
   - Descriptive title of the Invention
   - Cross Reference to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (if filed)
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [x] Drawing(s) (35 USC 113) [*Total Sheets* 2]
4. Oath of Declaration [*Total Pages* 2]
   a. [ ] Newly executed (original copy)
   b. [ ] Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional with Box 17 completed)* **[Note Box 5 below]**
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. [ ] Incorporation By Reference *(useable if Box 4b is checked)* The entire disclosure of the prior application, from which a copy of the oath of declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. [ ] Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [x] Assignment Papers (cover sheet & document(s))
9. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
10. [ ] English Translation Document (if applicable)
11. [ ] Information Disclosure Statement (IDS)/PTO-1448 [ ] Copies of IDS Citations
12. [ ] Preliminary Amendment
13. [x] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
14. [ ] Small Entity Statement(s) [ ] Statement filed in prior application, Status still proper and desired
15. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. [x] Other: Certificate of Express Mailing

17. **If a CONTINUING APPLICATION,** *check appropriate box and supply the requisite information:*
    [ ] Continuation [ ] Reissue [ ] Continuation-in-part (CIP) of prior application No: _____

18. CORRESPONDENCE ADDRESS

[ ] *Customer Number or Bar Code Label* *(Insert Customer No. or Attach bar code label here)* or [x] Correspondence address below

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PATENT
00-1010

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09/687007
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
FEE TRANSMITTAL LETTER

October 12, 2000

The Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application, including four (4) sheet(s) of drawing, of inventor(s): Richard A. Bramley, Jr.
for: Use of Extra Firmware Flash ROM Space as Diagnostic Drive

Applicant is a small entity ☐; large entity ☒
The filing fee for this application is calculated below:

FOR:	CLAIMS AS FILED		RATE		TOTAL
Basic Fee			$ 710.00	=	$ 710.00
Total Claims	14 - 20 = 0	times	$ 18.00	=	$ 0.00
Independent Claims	2 - 3 = 0	times	$ 80.00	=	$ 0.00
Multiple Dependent Claims	0	times	$ 270.00	=	$ 0.00
TOTAL FILING FEE					$ 710.00
Assignment Recording Fee	1	times	$ 40.00	=	$ 40.00
TOTAL FEES					$ 750.00

A cheque in the amount of **$ 750.00** is enclosed with this Application Transmittal Letter to cover the filing fees. This form is submitted in duplicate.

Respectfully submitted

Kenneth W. Float
Reg. No. 29,233

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PATENT
00-1010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Richard A. Bramley, Jr.	: Date: October 12, 2000
Serial No.	: Group Art Unit:
Filed:	: Examiner:
For: Use of Extra Firmware Flash ROM Space as Diagnostic Drive	: Batch No.:

CERTIFICATE OF MAILING UNDER 37 CFR 1.10

The Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Identification of Transmitted Papers

Utility Patent Application Transmittal form, patent application comprising ten (10) pages plus a cover page, two (2) sheets of drawing, Combined Declaration and Power of Attorney form, Assignment for recording, Recordation form cover sheet (PTO-1595), Fee Transmittal Letter in duplicate, two cheques totaling $750.00, and return receipt postcard

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CERTIFICATION OF EXPRESS MAIL DEPOSIT

"EXPRESS MAIL" MAILING LABEL NO. EF336478970US

DATE OF DEPOSIT -October 13, 2000

I hereby certify that the above-identified correspondence is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service, under 37 CFR 1.10, on the date indicated above and addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

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Docket No. 200204.0

PATENT
PD-00-1010

USE OF EXTRA FIRMWARE FLASH ROM SPACE AS A DIAGNOSTIC DRIVE

Richard A. Bramley, Jr.

10020704-030299

USE OF EXTRA FIRMWARE FLASH ROM SPACE AS A DIAGNOSTIC DRIVE

BACKGROUND

The present invention relates generally to computer systems and methods, and more particularly, to a system and method that provides for the use of available firmware flash ROM space as a diagnostic drive.

The assignee of the present invention develops firmware known as a basic input and output system, or BIOS that is employed in variously available computer systems. The BIOS is a firmware program that is typically stored in a nonvolatile random access memory (or flash memory). The BIOS brings up the computer system when it is turned on.

On IA-64 computer systems, manufactured by Intel, for example, 16MB of address space has been reserved for flash ROM storage of the firmware (BIOS). The firmware developed by the assignee of the present invention may be adapted to fit within about 4MB of disk space, leaving about 12MB free (if the OEM populates the chips).

There are numerous patents disclosing how to implement read only memory technology as a disk drive. However, there are no patents that disclose or suggest the use of the extra firmware flash ROM as a disk drive containing diagnostics.

It is an objective of the present invention to use this available flash ROM storage space in a manner not heretofore done in the computer industry. It is an objective of the present invention to provide for a system and method that provides for the use of available firmware flash ROM space as a diagnostic drive.

SUMMARY OF THE INVENTION

To accomplish the above and other objectives, the present invention provides for system and method that provides for the use of available firmware flash ROM space as a diagnostic drive. The present invention is employed on a computer system that includes a central processing unit and a nonvolatile random access memory. The computer system has an Extensible Firmware Interface, which is a ROM-based operating system stored in the nonvolatile random access memory that provides disk operating system (DOS) functionality for the computer system. The Extensible Firmware Interface is controlled by the basic input and output system and executes before any other operating systems are loaded or disk access is allowed.

The general purpose of the present invention is to use the unused ROM space in flash memory available on a server or other computer system as a hard drive that stores diagnostic programs and data. Using available flash ROM space means that there isn't any way to lose the diagnostic programs or to run them with the wrong operating system.

As mentioned above, in IA-64 systems, 16MB of address space is reserved for flash ROM storage of firmware. The firmware created by the assignee of the present invention fits easily within about 4MB of disk space, leaving about 12MB free for use as a diagnostic drive (if the OEM populates the chips).

A preferred embodiment of the present invention contemplates that the use of an Extensible Firmware Interface (EFI) driver that allows the flash-based storage area to appear as a standard block device (a hard disk drive, for example) that is selectable from the command shell (which is part of the Extensible Firmware Interface). The EFI provides DOS (Disk Operating System) functionality. The EFI is controlled by the BIOS of the computer system and executes before any other operating systems are loaded or disk access is allowed.

The Extensible Firmware Interface has a command shell, which is the outermost layer or user interface of this program, and which has a command processor interface. The command processor is a program that executes operating system commands. The command shell is that part of the command processor that accepts commands. After verifying that the commands are valid, the shell sends them to another part of the command processor to be executed.

It may also be desirable to build data compression and decompression support directly into the EFI driver to increase the quantity of data that may be stored. The diagnostic drive may also be used to store power on self test (POST) error logs in files that may be read by the operating system during its boot process and displayed by an

event viewer. The diagnostic drive may also be configured to support encryption for security purposes.

While it is possible to provide drivers for various operating systems used in available computer systems (DOS, NT, Win9x, etc.) these are less interesting because it is expected that the majority of new diagnostics will be written as EFI applications that can be run from the EFI command shell. By providing access as an EFI drive, the computer platform does not require a functional mass storage device to run the diagnostics. As EFI applications, an operating system is also not needed for its operation and there is no possibility for the diagnostics to be run on the wrong operating system.

Since the firmware is structured as a number of discrete binary images residing in flash ROM, these could also be located as files on the diagnostic drive. This makes it easy to update the firmware, by simply copying a new file to the diagnostic drive. Using this aspect of the present invention, a change in a disk driver would support loading binary images from a standard hard disk or from a server processor across a network or serial link.

An exemplary method in accordance with the present invention is used with a computer system that includes a central processing unit, a nonvolatile random access memory, an Extensible Firmware Interface (EFI), and a basic input and output system. The method comprises the following steps. An Extensible Firmware Interface (EFI) driver is added which allows the unused flash-based storage area to appear as a standard block device (a hard disk drive, for example) that is selectable from the command shell (which is part of the Extensible Firmware Interface). Diagnostic programs are stored in unused memory space of the nonvolatile random access memory which are accessible via the Extensible Firmware Interface. If the computer fails to boot its operating system due to a problem with the hard disk drive, a user boots the system to the EFI command shell and the user runs a diagnostic program from the diagnostic drive. The program finds the error and corrects it. The user then reboots the computer system which successfully boots the operating system on the hard disk drive.

BRIEF DESCRIPTION OF THE DRAWINGS

The various features and advantages of the present invention may be more readily understood with reference to the following detailed description taken in conjunction with the accompanying drawing, wherein like reference numerals designate like structural elements, and in which:

Fig. 1 illustrates an exemplary computer system in which the present invention is employed;

Fig. 2 illustrates details of the present invention; and

Fig. 3 is a flow diagram that illustrates an exemplary method in accordance with the principles of the present invention for using the unused space of a flash memory as a hard disk drive to store diagnostic programs and data.

DETAILED DESCRIPTION

Referring to the drawing figures, Fig. 1 illustrates an exemplary computer system 10 in which the present invention may be employed. The computer system 10 comprises a central processing unit (CPU) 11 which is coupled to a hard disk drive 12 and a nonvolatile random access memory (NVRAM) 14, also known as flash memory 14. A hard disk drive 12 is shown as part of the system 10, which is typically the case, although one is not necessarily required.

The computer system 10 also comprises a basic input and output system (BIOS) 16, which is stored in the flash memory 14. As will be discussed below, the BIOS 16 is stored in a relatively small portion of the flash memory 14. The computer system 10 also comprises an Extensible Firmware Interface (EFI) 15 which is a ROM-based operating system that is stored in the flash memory 14 that provides disk operating system (DOS) functionality for the computer system 10. The Extensible Firmware Interface 15 is controlled by the BIOS 16 and executes before any other operating systems are loaded or disk access is allowed.

The Extensible Firmware Interface 15 comprises a command shell, which is the outermost layer or user interface of this program, and which has a command processor interface. The command processor is a program that executes operating system commands. The command shell is that part of the command processor that accepts commands. After verifying that the commands are valid, the shell sends them to another part of the command processor to be executed.

An EFI device driver 17 is an application that is written to run under the Extensible Firmware Interface 15. The specific EFI device driver 17 employed in the present invention may be referred to as a "flash as a diagnostic drive" EFI driver 17 as is illustrated in Fig. 2. There are typically many EFI drivers that are used, including one to handle a video display, one for a keyboard, one for the serial ports, and so forth.

The BIOS 16 brings up the computer system 10 when it is turned on. The BIOS 16 determines what the computer can do without accessing programs from the hard disk 12 or other media. The BIOS 16 contains code required to control the keyboard, display screen, disk drives, serial communications, for example, along certain other functions, depending upon the computer system 10.

A preferred embodiment of the present invention uses the EFI driver 17 to configure the available portion of the flash-based storage area (drive space 16a of the

flash memory 14) to appear as a standard block device (a hard disk drive, for example). Diagnostic programs are loaded into the configured disk drive space 16a of the flash memory 14. The block device configured by the EFI driver 17 is selectable by a boot manager that is part of the BIOS 16.

The "diagnostic drive" portion of the flash memory 14 may be used when the computer system 10 is booted, and the EFI device driver 17 makes the unused part of the flash ROM space appear as a block device (e.g., a hard drive). If the driver 17 had not been loaded before, this space appears as an empty hard drive. The manufacturer or user of the computer system 10, copies the diagnostic programs onto this "hard drive". At this point if the computer system 10 were turned off then back on, these diagnostic programs would still be stored in the drive. When the user encountered problems with the computer system 10, the command shell could be loaded and this "hard drive" with the diagnostic programs could then be accessed to diagnose and remedy the problem.

Referring to Fig. 2, it illustrates details involved in implementing the present invention. In a typical IA-64 computer system 10, 16MB of address space is reserved for storage of firmware in the flash memory 14. The firmware created by the assignee of the present invention fits easily within about 4MB of disk space, which, in the case of the IA-64 computer system 10, leaves about 12MB free for use as a diagnostic drive (if the OEM populates the chips).

The unused space in the flash memory 14 is controlled by the EFI driver which configures this portion 16a of the flash memory 14 to function like a conventional disk drive (such as the hard disk drive 12 shown in Fig. 1). Diagnostic programs are then loaded into the configured disk drive space 16a of the flash memory 14 and is controlled by the BIOS 16 by way of the EFI driver 17.

The EFI driver 17 may also be configured to support data compression and decompression in a conventional manner. This will increase the quantity of data that may be stored in the configured disk drive space 16a of the flash memory 14. The diagnostic disk drive space 16a may also be used to store power on self test (POST) error logs in files that may be read by the operating system during its boot process and displayed by an event viewer. The diagnostic drive may also be configured to support encryption for security purposes. An example of what files might exist on the diagnostic drive and how they might appear in the command shell is shown in the large display box at the lower portion of Fig. 2.

Fig. 3 is a flow diagram that illustrates an exemplary method 20 in accordance with the principles of the present invention for using unused space of a flash memory 14 as a hard disk drive 16a to store diagnostic programs and data. The method 20 is

used with a computer system 10 having a central processing unit (CPU) 11, a nonvolatile random access memory (NVRAM) 14 or flash memory 14, a basic input and output system (BIOS) 16, and an Extensible Firmware Interface 15.

The method 20 comprises software 20, and preferably firmware 20, implemented using an EFI driver 17 that is stored and executed from the flash memory 14. The method 20 comprises the following steps. A command shell of the Extensible Firmware Interface 15 is modified 21 to include the EFI driver 17 that operates to configure available flash ROM space normally reserved for firmware (BIOS) 16 as a diagnostic disk drive 16a. The modified Extensible Firmware Interface 15 and the EFI driver 17 are stored 22 in the flash memory 14.

When the computer system 10 is initialized (booted), the EFI driver 17 configures 23 the available space in the flash memory 14 that is not allocated to the firmware 16 as the diagnostic disk drive 16a. One or more diagnostic programs are loaded 24 into the diagnostic disk drive 16a, which are selectively run 25 by a user, such as by using the command shell if the computer system 10 has a problem with the hard disk drive 16a.

If the computer system 10 fails to boot its operating system due to a problem with the hard disk drive 16a, a user selectively boots 26 the computer system to the EFI command shell. The user selectively runs 27 one or more hard drive diagnostic programs from the diagnostic drive. The diagnostic program finds the error and corrects it. The user then reboots 28 the computer system 10 which successfully boots the computer system from the hard disk drive.

The software 20 or firmware 20 that implements the method 20 may also be configured 29 to include data compression and decompression routines, or encryption routines for security purposes. The data compression and decompression routines increase the quantity of data that may be stored in the configured disk drive space 16a of the flash memory 14. The diagnostic disk drive space 16a may be used to store 30 the POST error logs in files that may be read by the operating system during its boot process and displayed by an event viewer.

Thus, system and method that provides for the use of available firmware flash ROM space as a diagnostic drive have been disclosed. It is to be understood that the above-described embodiments are merely illustrative of some of the many specific embodiments that represent applications of the principles of the present invention. Clearly, numerous and other arrangements can be readily devised by those skilled in the art without departing from the scope of the invention.

Docket No. 200309-1

CLAIMS

What is claimed is:

1. A method for using available firmware flash ROM space as a diagnostic drive of a computer system that includes a central processing unit, a hard disk drive, a nonvolatile random access memory, an Extensible Firmware Interface (EFI), and a basic input and output system, the method comprising the steps of:

modifying the Extensible Firmware Interface to include an EFI driver that operates to configure available flash ROM space normally reserved for the BIOS as a diagnostic disk drive;

storing the modified Extensible Firmware Interface and the EFI driver in the nonvolatile random access memory;

when the computer system 10 is initialized, configuring the available space in the flash memory that is not allocated to the firmware as a diagnostic disk drive;

loading one or more diagnostic programs into the diagnostic disk drive;

selectively booting the computer system to the EFI command shell in the event of a problem with the computer system;

running the one or more diagnostic programs to correct the problem with the computer system; and

rebooting the computer system using the operating system on the hard disk drive.

2. The method recited in Claim 1 which comprises software.

3. The method recited in Claim 1 which comprises firmware.

4. The method recited in Claim 1 wherein the step of selectively running the diagnostic programs comprises displaying the diagnostic programs using an event viewer.

5. The method recited in Claim 1 further comprising the step of configuring the EFI driver to include data compression and decompression routines to increase the quantity of data stored in the diagnostic disk drive.

6. The method recited in Claim 1 further comprising the step of configuring the EFI driver to include encryption routines for security purposes.

Docket No. 200407-1

7. The method recited in Claim 1 wherein the diagnostic disk drive space is used to store power on self test (POST) error logs in files that may be read and displayed.

8. The method recited in Claim 7 wherein the POST error logs in files are read by the operating system during its boot process and are displayed by an event viewer.

9. Computer apparatus comprising:

a central processing unit;

a nonvolatile random access memory;

an Extensible Firmware Interface (EFI);

a basic input and output system (BIOS) stored in the nonvolatile random access memory; and

an EFI driver stored in the nonvolatile random access memory that interfaces with the Extensible Firmware Interface, and operates to configure available flash read-only-memory space normally reserved for the BIOS as a diagnostic disk drive, load one or more diagnostic programs into the diagnostic disk drive, selectively boot the computer system to the EFI command shell in the event of a problem with the hard disk drive, run the one or more diagnostic programs to correct the problem with the hard disk drive, and reboot the computer system using the operating system on the hard disk drive.

10. The computer apparatus recited in Claim 9 which further comprises an event viewer for displaying the diagnostic programs.

11. The computer apparatus recited in Claim 9 wherein the EFI driver includes data compression and decompression routines to increase the quantity of data stored in the diagnostic disk drive.

12. The computer apparatus 1 recited in Claim 9 wherein the EFI driver includes encryption routines for security purposes.

13. The computer apparatus recited in Claim 9 wherein the diagnostic disk drive space stores power on self test (POST) error logs in files that may be read and displayed.

14. The computer apparatus recited in Claim 13 wherein the POST error logs in files are read by the operating system during its boot process and are displayed by an event viewer.

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USE OF EXTRA FIRMWARE FLASH ROM SPACE AS A DIAGNOSTIC DRIVE

ABSTRACT

A method 20 and computer apparatus for using available firmware flash ROM space as a diagnostic drive. The computer apparatus has a nonvolatile random access memory, an Extensible Firmware Interface (EFI) and a basic input and output system (BIOS). To implement the functionality provided by the present invention, a command shell of the EFI is modified to include the EFI driver and operates to configure available flash space normally reserved for firmware (BIOS) as a diagnostic disk drive. The modified EFI and the EFI driver are stored in the flash memory. When the computer system 10 is initialized (booted), the EFI driver configures the available space in the flash memory that is not allocated to the firmware as the diagnostic disk drive. Diagnostic programs are loaded into the diagnostic disk drive, which are selectively run by a user, such as by using the command shell. The method may also be configured to include data compression and decompression routines to increase the quantity of data that may be stored in the configured disk drive space, or encryption routines for security purposes. The diagnostic disk drive space may be used to store power on self test (POST) error logs in files that may be read by the operating system during its boot process and displayed by an event viewer.

Docket No. 200309-1

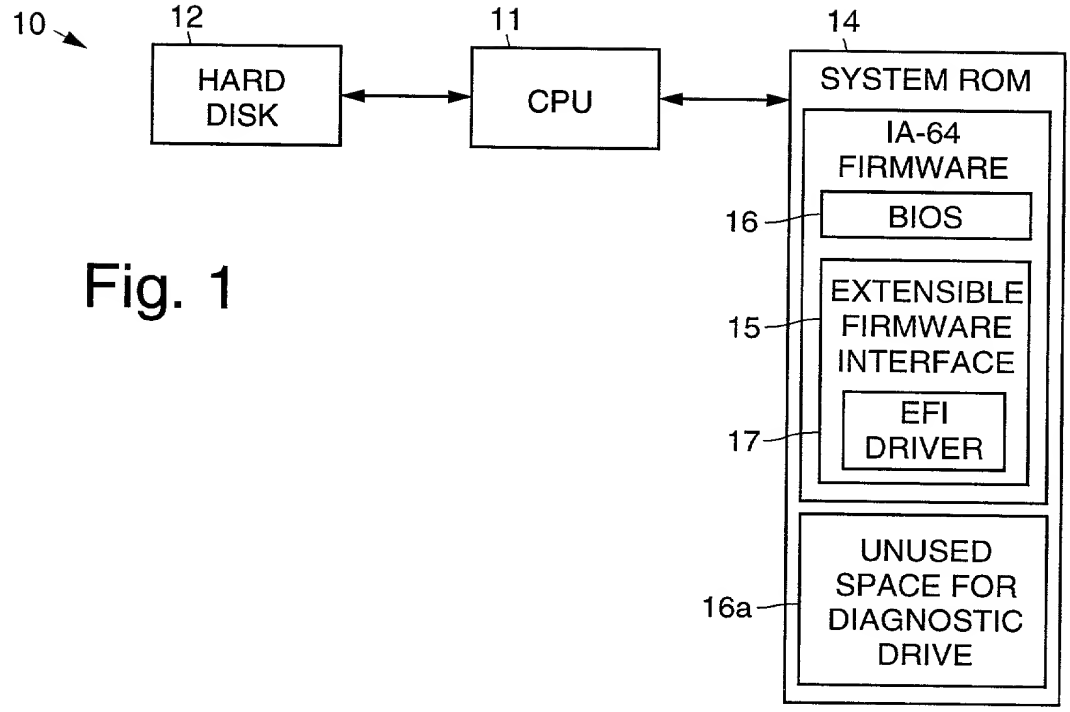


Fig. 1

Docket: 200.2959

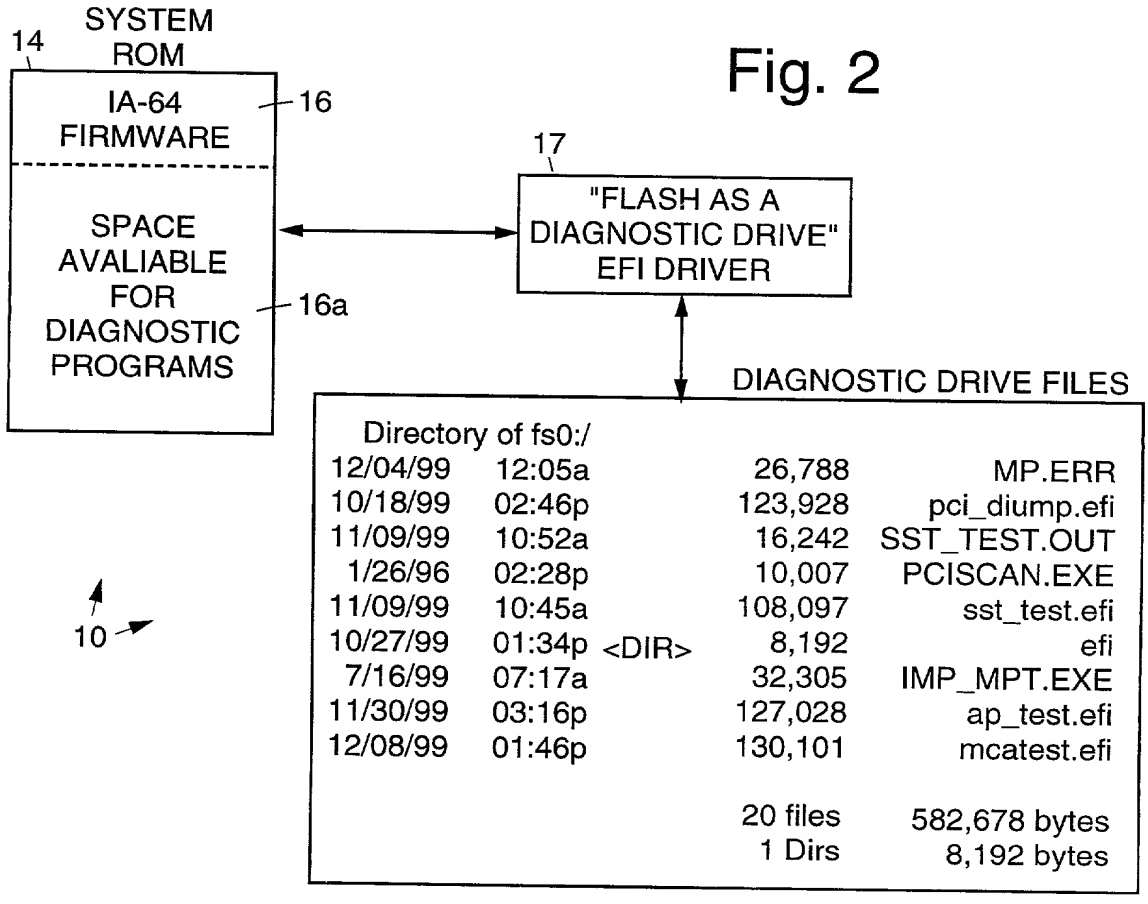
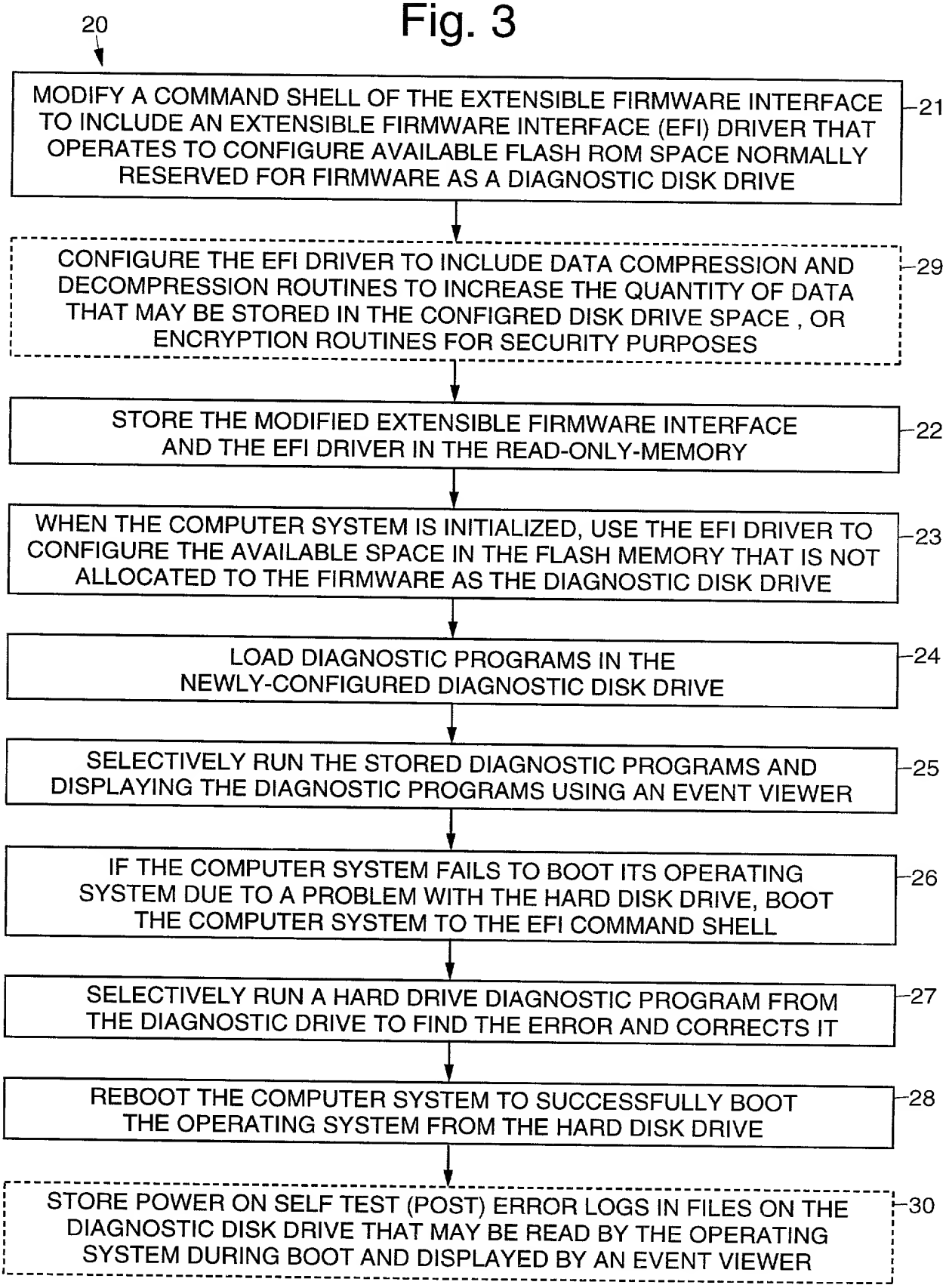


Fig. 2

Fig. 3



09/652,705

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

PD- 00-1010

- [X] Original
- [ ] Continuation
- [ ] Division
- [ ] Continuation-in-part
- [ ] Supplemental
- [ ] PCT
- [ ] Design

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled Use of Extra Firmware Flash ROM Space as Diagnostic Drive

the specification of which

(check one)

- [X] is attached hereto
- [ ] was filed on as Application Serial No. and (a) [other than supplemental] was amended on or (b) [supplemental] with amendments through

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Number	Country	Day/Month/Year filed	Priority Claimed Yes	Priority Claimed No
			☐	☐

I hereby claim the benefit under Title 35, United States Code, §120 of any United States applications(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	Filing Date	Status (patented, pending, abandoned)

I hereby appoint the following attorneys, or agent and attorneys, to prosecute the application and to transact all business in the Patent and Trademark Office in connected therewith:

Kenneth W. Float, Registration No. 29,233

Address all correspondence to Claudia Cameron, Legal Assistant, Phoenix Technologies Ltd., 411 East Plumeria Drive, San Jose, CA 95134. Please address telephone calls to Claudia Cameron at (408) 570-1038

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false

United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF SOLE OR FIRST JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
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POST OFFICE ADDRESS		
12 Gloria Drive, Mansfield, MA 02048		

FULL NAME OF JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
POST OFFICE ADDRESS		

FULL NAME OF JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
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